Buckley C, Galna B, Rochester L, Mazzà C.

Measuring upper body motion provides unique information about gait impairment in the early stages of Parkinson's disease.

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Title:

Measuring upper body motion provides a more accurate description of gait in early stages of Parkinson's disease

Abstract: **(Your abstract must use 10 point New Times Roman style and must fit into the box. Do not enter author details)**

Introduction: Upper body motion during gait may be a marker of incipient pathology, intervention response and disease progression in Parkinson's disease (PD) [1]. It is unknown whether variables obtained from the upper body during gait are merely a reflection of lower body mechanics or can they provide novel additional information of PD gait. If unique information can be gained, it may improve the objective characterisation of PD gait at the early stages of the disease when it is needed to inform intervention strategies and accurately quantify their effect.

Research Question: Can measuring upper body motion during gait provide unique information from lower body measurements and are they beneficial to classify early stage PD gait independently and in combination with traditional spatiotemporal lower body measurements?

Methods: Seventy participants with early stage PD (69.2 ± 9.9 yr, Female: 23, UPDRS III: 36.9 ± 12.3) and 64 age-matched controls (71.6 ± 6.8 yr, Female: 29) walked for two minutes around a 25m circuit. Sixteen spatiotemporal variables were measured using a 7m meter Gaitrite mat located along the circuit, and were selected *a priori* according a five-domain (pace, rhythm, variability, asymmetry and postural control) validated model of gait [2]. Upper body variables proposed in the literature to measure different aspects of gait (magnitude, smoothness, harmonicity, attenuation, regularity and symmetry) were calculated for anterio-posterior, mediolateral and vertical directions, using three inertial sensors (128 Hz, APDM) located at the head, neck and pelvis. This process resulted in 78 upper body variables [3]. A Pearson's product-moment correlations calculated if upper and lower body variables are unique form each other. A univariate (receiver operator characteristic (ROC) curve) analysis was used to quantify how well upper body variables alone could discriminate the PD group from the controls. Binary logistic regression analysis was performed to determine whether the upper body variables provide additional discriminative information when combined with lower body variables.

Results: Apart from the lower body domains of pace being strongly correlated with regularity and mildly correlated with symmetry, and rhythm being mildly correlated with magnitude and smoothness, upper and lower body gait domains did not significantly correlate. The univariate analysis showed that 44 of the 78 upper body variables significantly discriminated PD from control participants ($p<.05$). When the 16 spatiotemporal characteristics were entered (forward stepwise) into a binary logistic regression, the model classified group membership with 74% accuracy. Upper body variables resulted in a model with 83% accuracy. When spatiotemporal characteristics entered the model first and upper body variables were added as a second step, the latter variables significantly contributed ($p<.001$) to an increase of 16% in the accuracy of the prediction model (from 74% to 90%).

Discussion: Most upper body variables provided additional and unique information about PD gait with respect to traditional spatiotemporal variables obtained from the lower body. Univariate and multivariate analyses showed that this additional information was increasingly beneficial in discriminating/ classifying movements symptomatic to early PD. Due to the upper body measurements providing additional classification accuracy to the lower body gait model, we recommend that if to be used as a biomarker, assessing upper body variables in conjunction to traditional variables will create a more holistic characterisation of PD gait.

References:

1. Hubble R, et al., Plos one 2015; 10:1-22
2. Lord S, et al., J Gerontol A Biol Sci Med Sci 2013; **66**:820-827
3. Buckley C, et al., Gait Posture 2017; 52: 265–271